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CONTRACTOR'S REPORT

VOLUME 2 - PROPOSED STANDARDS
AND ACM MANUAL CHANGES

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Proposed Standards and ACM Manual Changes

This Contractor Report, prepared by Berkeley Solar Group, Enercomp, Inc., Proctor Engineering and Modera Consulting Engineers, documents the proposed language changes to the Residential Building Energy Efficiency Standards and the ACM Manual. This report is intended for discussion at an Efficiency Standards Committee hearing on November 28, 2000. The hearing purpose is to obtain public comment on this report and revisions to the Title 24 Building Energy Efficiency Standards (California Code of Regulations, Title 24, Part 6).

November 17, 2000

AB970 Residential Building Energy Efficiency Standards

Volume II

Proposed Standards and ACM Manual Changes

Preface

The proposed AB970 changes for Residential Buildings are documented in three parts. Volume I summarizes the proposed changes. Volume II documents the proposed language changes to the Standards and the ACM Manual. Volume III provides the analysis and impact of the proposed changes.

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November 17, 2000

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A. Administrative Definitions, Section 10-102

ALTERNATIVE CALCULATION METHOD APPROVAL MANUAL or **ACM MANUAL** is the Alternative Calculation Method (ACM) Approval Manual for the ~~1998~~2001 Energy Efficiency Standards for Nonresidential Buildings, ~~1998~~2001, (P400-~~98~~00-011) for nonresidential buildings, hotels, and multi-family residential buildings with four or more stories and the Alternative Calculation Method (ACM) Approval Manual for the ~~1998~~2001 Energy Efficiency Standards for Residential Buildings, ~~1998~~2001, (P400-~~98~~00-003) for all single family and low-rise multi-family residential buildings.

B. Calculation Methods, Section 10-109(b)2.

Procedural requirements for alternative calculation methods. In order to obtain approval of an ACM, the applicant must comply with the requirements, specifications, and criteria set forth in the appropriate ACM Manual. The ACM Manual specifies application requirements, minimum modeling capabilities, required output forms and instructions, input assumptions, testing requirements, test approval criteria, vendor requirements, and other related requirements. The requirements, specifications, and criteria in the ACM Manuals for the ~~*1998*~~*2001 Energy Efficiency Standards for Residential and Nonresidential Buildings* are hereby incorporated by reference.

C. Cool Roof Rating Council, Section 10-113

SECTION 10-113 – CERTIFICATION AND LABELING OF ROOFING PRODUCT REFLECTANCE AND EMITTANCE

This section establishes rules for implementing labeling and certification requirements relating to reflectance and emittance for roofing products for showing compliance with Sections 141 and 151(b) of Title 24, California Code of Regulations, Part 6. This section also provides for designation of the Cool Roof Rating Council (CRRC) as the supervisory entity responsible for administering the state's certification program for roofing products, provided CRRC meets specified criteria.

(a) **Labeling Requirements.** Effective January 1, 2003, every roofing product installed in construction to take compliance credit for reflectance and emittance under Sections 141 and 151(b) shall have a clearly visible packaging label that lists the reflectance and emittance tested in accordance with the following ASTM Standards. Product reflectance and emittance ratings determined through these testing procedures shall be placed on a label on all packaging that contains the product. The words “Manufacturer stipulates that this rating was determined in accordance with applicable CRRC procedures” followed by the rating procedure number and certified reflectance and emittance shall be placed on

the packaging of the roofing products. The label shall also state any limitations or conditions of the applicability of the rating to installed roofing products.

ASTM E1918-97 – Standard Test Method for Measuring Solar Reflectance of Horizontal and Low Sloped Surfaces in the Field.

ASTM E903-96 – Standard Test Method for Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres.

ASTM E408-71(1996)e1 – Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.

ASTM C1371-98 – Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.

(b) **Certification Requirements.** Effective January 1, 2003 every roofing product installed in construction to take compliance credit for reflectance and emittance under Sections 141 and 151(b) shall be certified only by CRRC or another supervisory entity approved by the commission pursuant to Section 10-113(c).

(c) **Designation of Supervisory Entity.** The Cool Roof Rating Council shall be the supervisory entity to administer the certification program relating to reflectance and emittance ratings for roofing products, provided the commission determines that the CRRC meets the criteria in paragraph (d).

1. The commission may consider designating a supervisory entity other than CRRC only if the commission determines that the CRRC cannot meet the criteria in paragraph (d) by January 1, 2002. Such other supervisory entity shall meet the criteria in paragraph (d) prior to being designated.

2. The commission shall periodically review, at least annually, the structure and operations of the supervisory entity to ensure continuing compliance with the criteria in paragraph (d).

(d) **Criteria for Supervisory Entity.**

1. Membership in the entity shall be open on a nondiscriminatory basis to any person or organization that has an interest in uniform performance ratings for roofing products, including, but not limited to, members of the roofing industry, building industry, design professionals, specifiers, utilities, government agencies, and public interest organizations. The membership shall be composed of a broad cross section of those interested in uniform ratings for roofing products.

2. The governing body of the entity shall reflect a reasonable cross-section of the interests represented by the membership.

3. The entity shall maintain a program of oversight of product manufacturers, laboratories, and independent certifying organizations that ensures uniform application of the ASTM Standards E408, E903, E1918, C1371 testing and rating procedures, labeling and certification, and such other rating procedures for other factors affecting energy performance as the CRRC and the commission may adopt.

4. The entity shall require manufacturers and independent certifying organizations within its program to use only laboratories accredited by the supervisory entity to perform tests under the CRRC rating procedure.

5. The entity shall maintain appropriate guidelines for testing laboratories and manufacturers, including requirements for adequate:

   a. Possession and calibration of equipment;
   b. Education, competence, and training of personnel;
   c. Quality control;
   d. Record keeping and reporting;
   e. Periodic review (including, but not limited to, blind testing by laboratories; inspections of products; and inspections of laboratories);
   f. Challenges to certified ratings; and
   g. Guidelines to maintain the integrity of the program, including, but not limited to, provisions to avoid conflicts of interest within the rating and certification process.

6. The entity shall be a nonprofit organization and shall maintain reasonable, nondiscriminatory fee schedules for the services it provides and shall make its fee schedules, the financial information on which fees are based, and financial statements available to its members for inspection.

7. The entity shall provide hearing processes that give laboratories, manufacturers, and certifying agencies a fair review of decisions that adversely affect them.

8. The entity shall maintain a certification policy committee whose procedures are designed to avoid conflicts of interest in deciding appeals, resolving disputes, and setting policy for the certifying organizations in its program.

9. The entity shall publish at least annually a directory of products certified and decertified within its program.

10. The entity itself shall be free from conflict-of-interest ties or to undue influence from any particular roofing product manufacturing interest(s), testing or simulation lab(s), or independent certifying organization(s).

11. The entity shall provide or authorize the use of labels that can be used to meet the requirements for showing compliance with the requirements of Sections 141 and 151(b), and this section.

12. The entity's certification program shall allow for multiple participants in each aspect of the program to provide for competition between manufacturers and between testing labs.

D. Definitions, Section 101(b)

CMC means the 1998 California Mechanical Code.

. . .

COOL ROOF is a roofing material with high solar reflectance and high emittance that reduces heat gain through the roof.

. . .

DUCT SEALING is a procedure for installing a space conditioning distribution system that minimizes leakage of conditioned air. Minimum specifications for installation procedures, materials, diagnostic testing and field verification are contained in the ACM Approval Manual.

. . .

RADIANT BARRIER is any reflective material that has an emissivity of 0.05 or less, tested in accordance with ASTM C-1371-97, and that is certified to the California Department of Consumer Affairs.

. . .

THERMOSTATIC EXPANSION VALVE (TXV) is a refrigerant metering valve that controls the flow of liquid refrigerant entering the evaporator in response to the superheat of the gas leaving it.

E. Fenestration Solar Heat Gain Coefficient Default Table, Section 116

TABLE 1-E—DEFAULT SOLAR HEAT GAIN COEFFICIENT

FRAME TYPE	PRODUCT	GLAZING	TOTAL WINDOW SHGC	
			Single Pane	Double Pane
Metal	Operable	~~Uncoated~~Clear	0.80	0.70
Metal	Fixed	~~Uncoated~~Clear	0.83	0.73
Metal	Operable	Tinted	0.67	0.59
Metal	Fixed	Tinted	0.68	0.60
Metal, Thermal Break	Operable	~~Uncoated~~Clear	0.72	0.63
Metal, Thermal Break	Fixed	~~Uncoated~~Clear	0.78	0.69
Metal, Thermal Break	Operable	Tinted	0.60	0.53
Metal, Thermal Break	Fixed	Tinted	0.65	0.57
Nonmetal	Operable	~~Uncoated~~Clear	0.74	0.65
Nonmetal	Fixed	~~Uncoated~~Clear	0.76	0.67
Nonmetal	Operable	Tinted	0.60	0.53
Nonmetal	Fixed	Tinted	0.63	0.55

SHGC = Solar Heat Gain Coefficient.

F. Mandatory Duct Construction, Section 150(m)

(m) Air-distribution System Ducts, Plenums, and Fans.

1. **UMC compliance.** All air-distribution system ducts and plenums, including, but not limited to, ~~building cavities,~~ mechanical closets~~,~~ and air-handler boxes ~~and support platforms used as ducts or plenums~~, shall be installed, sealed and insulated to meet the requirement of the ~~ICBO 1997 UMC~~ 1998 CMC Sections 601, 603, 604, and Standard 6-3, incorporated herein by reference. Portions conveying conditioned air shall either be insulated to a minimum installed level of R-4.2 (or any higher level required by ~~U~~CMC Section 604) or be enclosed entirely in conditioned space. Connections of metal ducts and the inner core of both factory fabricated and field fabricated flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

   Building cavities, support platforms for air handlers, and plenums defined or constructed with materials other than sealed sheet metal, duct board or flexible duct shall not be used for conveying conditioned air. Building cavities and support platforms may contain ducts. Ducts installed in cavities and support platforms shall not be compressed to cause reductions in the cross sectional area of the ducts.

2. **Factory-fabricated duct systems.**

. . .

C. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 or UL 181B.

Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands;

3. **Field-fabricated duct systems.**

. . .

C. **Pressure-sensitive tape.** Pressure-sensitive tapes shall comply with UL 181, UL 181A, or UL 181B.

Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands;

G. Performance Compliance

Multiple Orientation Alternative, Section 151(c)

MULTIPLE ORIENTATION ALTERNATIVE to Section 151 (c): A permit applicant may demonstrate compliance with the energy budget requirements of Section 151 (a) and (b) for any orientation of the same building model if the documentation demonstrates that the building model with its proposed designs and features would comply in each of the four cardinal orientations.

~~In the four compliance demonstrations, all designs and features must be the same, except that a model may differ in its shading in order to show compliance in the four cardinal directions.~~

Interior shading devices, Section 151(e)

6. Solar heat gain coefficients for interior shading devices used with fenestration products shall be 0.68 for vertical fenestration products and 1.0 for non-vertical fenestration products. ~~for draperies, 0.47 for blinds, and 0.47 for roller shades until December 31, 2001. Beginning January 1, 2002, roller shades shall not be used as an interior shading device for compliance.~~ No other solar heat gain coefficients shall be used for interior shading. The calculations for vertical fenestration products ~~may~~ include the effects of draperies and insect screens without installation being verified at the time of final inspection.

H. Prescriptive Requirements

Radiant Barrier, Section 151(f)2

2. **Radiant Barrier**. A radiant barrier required in Tables 1-Z1 through 1-Z16 is any reflective material that has an emissivity of 0.05 or less, tested according to ASTM C-1371-97, and that is certified to the Department of Consumer Affairs. Installation criteria are contained in the Section 4.24 of the ACM Manual.

References to Packages A and B, Section 151

~~2~~3. **Glazing.**

…

~~C. For Package A, the south-facing glazing area percentage (glass area/conditioned floor area) shall not be less than the percentage in Tables 1-Z1 through 1-Z16. South-facing glazing includes glazing in ceilings which is horizontal, tilted to the south, or tilted in any other direction at a pitch less than 1:12. North-facing, east-facing, and west-facing glazing includes glazing in ceilings which is tilted at a pitch of 1:12 or greater to the north, east, and west, respectively.~~

~~4~~5. **Thermal mass.** Thermal mass required for Package~~s A and~~ C in Tables 1-Z1 through ~~—~~1-Z16 shall meet or exceed the minimum interior mass capacity specified in Table 1-U.

TABLE 1-U—INTERIOR MASS CAPACITY REQUIREMENTS FOR PACKAGE~~S A AND~~ C

PACKAGE	MINIMUM INTERIOR MASS CAPACITY
~~A~~	~~35.9 x south glazing area (ft.^{2})~~
C (slab floor)	2.36 x ground floor area (ft.^{2})
C (raised floor)	0.18 x ground floor area (ft.^{2})

Thermostatic Expansion Valves, Section 151(f)8

~~8~~9. **Space heating and space cooling.** When required by Tables ~~1~~-Z1 through 1-Z16, ducted split system and single package central air conditioners and ducted split system or single package heat pumps shall be equipped with a thermostatic expansion valve (TXV) with an access door or removable panel to verify installation of the TXV. All TXVs shall be confirmed through field verification and diagnostic testing as specified in the ACM Manual. All space-heating and space-cooling systems must comply with minimum appliance efficiency standards as specified in Sections 110 through 112.

Prescriptive Ducts Construction, Section 151(f)

~~7~~8. **Heating system type.** Heating system types shall be installed as required in Tables 1-Z1 through 1-Z16. A gas-heating system is a natural or liquefied petroleum gas-heating system. ~~All supply ducts shall either be in conditioned space or be insulated to a minimum installed level of R-4.2.~~

. . .

10. **Space conditioning ducts.** All supply ducts shall either be in conditioned space or be insulated to a minimum installed level of R-4.2 and constructed to meet minimum mandatory requirements of Section 150(m).

    All duct systems shall be sealed, as confirmed through field verification and diagnostic testing in accord with procedures set forth in the ACM Manual.

I. Alternative Component Packages

TABLE 1-Z1—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 1

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R49	R38
Wood-frame walls	~~R19~~	~~R19~~	R29	R21
"Heavy mass" walls	~~(R8.5)~~	~~(R5.0)~~	NA	(R4.76)
"Light mass" walls	~~[R8.5]~~	~~[R6.0]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R19~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R8
Radiant Barrier			NR	NR
GLAZING				
Maximum U-value[3]	~~0.65~~	~~0.65~~	0.40	0.65
Maximum total area	~~NR~~	~~16%~~	14%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	NR	NR
West-facing glazing	~~NR~~	~~NR~~	NR	NR
East-facing glazing	~~NR~~	~~NR~~	NR	NR
North-facing glazing	~~NR~~	~~NR~~	NR	NR
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~REQ~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~REQ~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			NR	NR
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-value and a 90% AFUE space-heating system can be substituted for duct sealing. All other requirements of Package D must be met.

Legend:
NR = Not Required NA = Not Applicable
REQ = Required MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z2—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 2

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R49	R30
Wood-frame walls	~~R13~~	~~R19~~	R29	R13
"Heavy mass" walls	~~(R2.3)~~	~~(R2.2)~~	NA	(R2.44)
"Light mass" walls	~~[R4.5]~~	~~[R4.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R8
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.40	0.65
Maximum total area	~~NR~~	~~14%~~	16%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
East-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z3—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 3

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R38	R30
Wood-frame walls	~~R13~~	~~R19~~	R25	R13
"Heavy mass" walls	~~(R4.5)~~	~~(R3.5)~~	NA	(R2.44)
"Light mass" walls	~~[R5.0]~~	~~[R5.0]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			NR	NR
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.40	0.75
Maximum total area	~~NR~~	~~16%~~	14%	20%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	NR	NR
West-facing glazing	~~NR~~	~~NR~~	NR	NR
East-facing glazing	~~NR~~	~~NR~~	NR	NR
North-facing glazing	~~NR~~	~~NR~~	NR	NR
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			NR	NR
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-value can be substituted for duct sealing. All other requirements of Package D must be met.

Legend:
NR = Not Required
NA = Not Applicable
REQ = Required
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z4—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 4

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R38	R30
Wood-frame walls	~~R13~~	~~R19~~	R25	R13
"Heavy mass" walls	~~(R3.5)~~	~~(R3.5)~~	NA	(R2.44)
"Light mass" walls	~~[R5.0]~~	~~[R5.0]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.40	~~0.75~~0.65
Maximum total area	~~NR~~	~~16%~~	14%	20%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
East-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			NR	NR
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient can be substituted for duct sealing. All other requirements of Package D must be met.

Legend:
NR = Not Required
NA = Not Applicable
REQ = Required
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z5—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 5

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R38	R30
Wood-frame walls	~~R13~~	~~R19~~	R25	R13
"Heavy mass" walls	~~(R2.4)~~	~~(R2.3)~~	NA	(R2.44)
"Light mass" walls	~~[R4.5]~~	~~[R4.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			NR	NR
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.40	0.75
Maximum total area	~~NR~~	~~14%~~	16%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	NR	NR
West-facing glazing	~~NR~~	~~NR~~	NR	NR
East-facing glazing	~~NR~~	~~NR~~	NR	NR
North-facing glazing	~~NR~~	~~NR~~	NR	NR
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			NR	NR
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-value can be substituted for duct sealing. All other requirements of Package D must be met.

Legend:
NR = Not Required
NA = Not Applicable
REQ = Required
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z6—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 6

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R19~~	~~R30~~	R38	R30
Wood-frame walls	~~R13~~	~~R19~~	R21	R13
"Heavy mass" walls	~~(R1.5)~~	~~(R1.6)~~	NA	(R2.44)
"Light mass" walls	~~[R4.0]~~	~~[R4.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~NR~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R21	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			NR	NR
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.50	0.75
Maximum total area	~~NR~~	~~16%~~	14%	20%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	NR	NR
West-facing glazing	~~NR~~	~~NR~~	NR	NR
East-facing glazing	~~NR~~	~~NR~~	NR	NR
North-facing glazing	~~NR~~	~~NR~~	NR	NR
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			NR	NR
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-value can be substituted for duct sealing. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z7—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 7

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R19~~	~~R30~~	R38	R30
Wood-frame walls	~~R13~~	~~R13~~	R21	R13
"Heavy mass" walls	~~(R1.7)~~	~~(R1.4)~~	NA	(R2.44)
"Light mass" walls	~~[R4.0]~~	~~[R3.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~NR~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R13~~	R21	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			NR	NR
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.50	0.~~75~~65
Maximum total area	~~NR~~	~~14%~~	14%	20%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
East-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			NR	NR
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient can be substituted for duct sealing. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z8—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 8

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R38	R30
Wood-frame walls	~~R13~~	~~R19~~	R21	R13
"Heavy mass" walls	~~(R1.6)~~	~~(R1.6)~~	NA	(R2.44)
"Light mass" walls	~~[R4.0]~~	~~[R4.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~NR~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R21	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.50	0.~~75~~65
Maximum total area	~~NR~~	~~14%~~	14%	20%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~0.40~~	~~0.40~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~0.40~~	~~0.40~~	0.40	0.40
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z9—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 9

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R38	R30
Wood-frame walls	~~R13~~	~~R19~~	R21	R13
"Heavy mass" walls	~~(R1.4)~~	~~(R1.5)~~	NA	(R2.44)
"Light mass" walls	~~[R4.0]~~	~~[R4.0]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R21	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.50	0.~~75~~65
Maximum total area	~~NR~~	~~14%~~	14%	20%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~0.40~~	~~0.40~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~0.40~~	~~0.40~~	0.40	0.40
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient, and an 11.0 SEER space-cooling system can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z10—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 10

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R49	R30
Wood-frame walls	~~R13~~	~~R19~~	R25	R13
"Heavy mass" walls	~~(R1.9)~~	~~(R2.0)~~	NA	(R2.44)
"Light mass" walls	~~[R4.5]~~	~~[R4.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R0
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~1.10~~	~~0.65~~	0.40	0.~~75~~65
Maximum total area	~~NR~~	~~16%~~	16%	20%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~0.40~~	~~0.40~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~0.40~~	~~0.40~~	0.40	0.40
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient, and an 11.0 SEER space-cooling system can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z11—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 11

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R49	R38
Wood-frame walls	~~R13~~	~~R19~~	R29	R19
"Heavy mass" walls	~~(R5.0)~~	~~(R5.5)~~	NA	(R4.76)
"Light mass" walls	~~[R6.0]~~	~~[R6.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R8
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~0.65~~	~~0.65~~	0.40	0.65
Maximum total area	~~NR~~	~~14%~~	16%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~0.40~~	~~0.40~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~0.40~~	~~0.40~~	0.40	0.40
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient, and a 12.0 SEER space-cooling system can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z12—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 12

COMPONENT	PACKAGE[1] A	B	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R30~~	R49	R38
Wood-frame walls	~~R13~~	~~R19~~	R29	R19
"Heavy mass" walls	~~(R3.5)~~	~~(R3.5)~~	NA	(R4.76)
"Light mass" walls	~~[R5.0]~~	~~[R5.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~NR~~	~~R7~~	R7	NR
Raised floors	~~R13~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R4
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~0.65~~	~~0.65~~	0.40	0.65
Maximum total area	~~NR~~	~~14%~~	16%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~0.40~~	~~0.40~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~0.40~~	~~0.40~~	0.40	0.40
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~NR~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient, and an 11.0 SEER space-cooling system can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required NA = Not Applicable
REQ = Required MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z13—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 13

COMPONENT	PACKAGE[1]				
	~~A~~	~~B~~	C[1]	D	
BUILDING ENVELOPE					
Insulation minimums[2]					
Ceiling	~~R30~~	~~R30~~	R49	R38	
Wood-frame walls	~~R13~~	~~R19~~	R29	R19	
"Heavy mass" walls	~~(R4.0)~~	~~(R4.0)~~	NA	(R4.76)	
"Light mass" walls	~~[R5.5]~~	~~[R6.0]~~	NA	NA	
Below-grade walls	~~NA~~	~~NA~~	NA	R0	
Slab floor perimeter	~~NR~~	~~R7~~	R7	NR	
Raised floors	~~R13~~	~~R19~~	R30	R19[2]	
Concrete raised floors	~~NA~~	~~NA~~	NA	R8	
Radiant Barrier			REQ	REQ	
GLAZING					
Maximum U-value[3]	~~0.65~~	~~0.65~~	0.40	0.65	
Maximum total area	~~NR~~	~~14%~~	16%	16%	
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR	
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR	
SOLAR HEAT GAIN COEFFICIENT[4]					
South-facing glazing	~~0.40~~	~~0.40~~	~~NR~~0.40	~~NR~~0.40	
West-facing glazing	~~0.40~~	~~0.40~~	0.40	0.40	
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40	
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40	
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR	
INFILTRATION CONTROL					
Continuous barrier	~~NR~~	~~NR~~	NR	NR	
Air-to-air heat exchanger	~~NR~~	~~NR~~	NR	NR	
SPACE-HEATING SYSTEM[6]					
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No	
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN	
If heat pump,					
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN	
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN	
SPACE-COOLING SYSTEM					
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN	
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN	
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*	
SPACE CONDITIONING DUCTS					
Duct sealing			REQ	REQ*	
DOMESTIC WATER-HEATING TYPE					
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any	

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.35 Solar Heat Gain Coefficient, and a 12.0 SEER space-cooling system can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z14—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 14

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R38~~	~~R38~~	R49	R38
Wood-frame walls	~~R19~~	~~R19~~	R29	R21
"Heavy mass" walls	~~(R7.0)~~	~~(R5.5)~~	NA	(R4.76)
"Light mass" walls	~~[R8.0]~~	~~[R6.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R19~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R8
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~0.65~~	~~0.65~~	0.40	0.65
Maximum total area	~~NR~~	~~16%~~	14%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~0.15~~	~~0.15~~	~~NR~~0.40	~~NR~~0.40
West-facing glazing	~~0.15~~	~~0.15~~	0.40	0.40
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~REQ~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~REQ~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.30 Solar Heat Gain Coefficient, and a 12.0 SEER space-cooling system can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z15—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 15

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R30~~	~~R38~~	R49	R38
Wood-frame walls	~~R19~~	~~R19~~	R29	R21
"Heavy mass" walls	~~(R5.5)~~	~~(R4.5)~~	NA	(R4.76)
"Light mass" walls	~~[R7.0]~~	~~[R6.0]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R0
Slab floor perimeter	~~R7~~	~~R7~~	R7	NR
Raised floors	~~R19~~	~~R19~~	R21	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R4
Radiant Barrier			REQ	REQ
GLAZING				
Maximum U-value[3]	~~0.65~~	~~0.65~~	0.40	0.65
Maximum total area	~~NR~~	~~16%~~	16%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~0.15~~	~~0.15~~	0.40	0.40
West-facing glazing	~~0.15~~	~~0.15~~	0.40	0.40
East-facing glazing	~~NR~~	~~NR~~	0.40	0.40
North-facing glazing	~~NR~~	~~NR~~	~~NR~~0.40	~~NR~~0.40
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~REQ~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~REQ~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			REQ	REQ*
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-value and maximum 0.30 Solar Heat Gain Coefficient, and a 13.0 SEER space-cooling system can be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:
NR = Not Required
REQ = Required
NA = Not Applicable
MIN = Minimum

See notes following Table 1-Z16

TABLE 1-Z16—ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 16

COMPONENT	PACKAGE[1]			
	~~A~~	~~B~~	C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling	~~R38~~	~~R38~~	R49	R38
Wood-frame walls	~~R19~~	~~R19~~	R29	R21
"Heavy mass" walls	~~(R9.5)~~	~~(R7.0)~~	NA	(R4.76)
"Light mass" walls	~~[R9.5]~~	~~[R7.5]~~	NA	NA
Below-grade walls	~~NA~~	~~NA~~	NA	R13
Slab floor perimeter	~~R7~~	~~R7~~	R7	R7
Raised floors	~~R19~~	~~R19~~	R30	R19[2]
Concrete raised floors	~~NA~~	~~NA~~	NA	R8
Radiant Barrier			NR	NR
GLAZING				
Maximum U-value[3]	~~0.65~~	~~0.65~~	0.40	0.60
Maximum total area	~~NR~~	~~16%~~	14%	16%
Maximum total nonsouth-facing area	~~9.6%~~	~~NR~~	NR	NR
Minimum south-facing area	~~6.4%~~	~~NR~~	NR	NR
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing	~~NR~~	~~NR~~	NR	NR
West-facing glazing	~~NR~~	~~NR~~	NR	NR
East-facing glazing	~~NR~~	~~NR~~	NR	NR
North-facing glazing	~~NR~~	~~NR~~	NR	NR
THERMAL MASS[5]	~~REQ~~	~~NR~~	REQ	NR
INFILTRATION CONTROL				
Continuous barrier	~~NR~~	~~REQ~~	NR	NR
Air-to-air heat exchanger	~~NR~~	~~REQ~~	NR	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed	~~No~~	~~No~~	Yes[7]	No
If gas, AFUE =	~~78%~~	~~78%~~	78%	MIN
If heat pump,				
split system HSPF[8] =	~~6.8~~	~~6.8~~	6.8	MIN
Single package system HSPF =	~~6.6~~	~~6.6~~	6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =	~~10.0~~	~~10.0~~	10.0	MIN
If single package A/C, SEER =	~~9.7~~	~~9.7~~	9.7	MIN
If ducted central air conditioner or heat pump, thermostatic expansion valve			NR	NR
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 9	~~Any~~	~~Any~~	Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-value and a 90% AFUE space-heating system can be substituted for duct sealing. All other requirements of Package D must be met.

Legend:
NR = Not Required NA = Not Applicable
REQ = Required MIN = Minimum

See notes following Table 1-Z16

NOTES TO THE LOW-RISE RESIDENTIAL PACKAGES IN TABLES 1-Z1 THROUGH 1-Z16

[1]~~Package A is a passive solar design requiring a significant amount of south-facing glazing, a small amount of nonsouth-facing glazing, and a large area of thermal mass. Package B allows a small area of glazing, with light and heavy mass wall alternatives; some zones require continuous infiltration barriers and air-to-air heat exchangers. Package C is the only package that allows electric-resistance space heating.~~ Package C may be used only if the building is in an area (1) where natural gas is not currently available and (2) where extension of natural gas service is impractical, as determined by the natural gas utility. Package D allows more glazing area in some zones with moderately high insulation levels; slab edge insulation is required in Climate Zone 16.

[2]The R-values shown for ceiling, wood frame wall and raised floor are for wood-frame construction with insulation installed between the framing members. For alternative construction assemblies, see Section 151 (f) 1 A.

The heavy mass wall R-value in parentheses is the minimum R-value for the entire wall assembly if the wall weight exceeds 40 pounds per square foot. The light mass wall R-value in brackets is the minimum R-value for the entire assembly if the heat capacity of the wall meets or exceeds the result of multiplying the bracketed minimum R-value by 0.65. Any insulation installed on heavy or light mass walls must be integral with, or installed on the outside of, the exterior mass. The inside surface of the thermal mass, including plaster or gypsum board in direct contact with the masonry wall, shall be exposed to the room air. The exterior wall used to meet the R-value in parentheses cannot also be used to meet the thermal mass requirement.

[3] For glazing U-value rating procedures and labeling requirements see Section 116 (a) 2.

[4] Values specified are maximum allowable values. ~~I~~If the package specifies a solar heat gain coefficient the builder shall meet the requirements of Section 151 (f) ~~3~~4.

[5] If the package requires thermal mass, meet the requirements of Section 151 (f) ~~4~~5.

[6] Automatic setback thermostats must be installed in conjunction with all space-heating systems in accordance with Section 151 (f) ~~9~~12.

[7] Ducts in Package C shall be insulated to an installed value of at least R-8.

[8] HSPF means "heating seasonal performance factor."

[9] Electric-resistance water heating is allowed as the main water heating source in Package C only if the water heater is located within the building envelope and a minimum of 25 percent of the energy for water heating is provided by a passive or active solar system or a wood stove boiler. The wood stove boiler credit is not allowed in Climate Zones 8, 10, and 15, nor in localities that do not allow wood stoves.

NOTE: Authority cited: Public Resources Code, Sections 25218(e), 25402, and 25402.1. Reference: Public Resources Code, Section 25402

J. Additions and Alterations

Fenestration in Small Additions, Section 152(a).

1. **Prescriptive approach**. Additions to existing buildings shall meet the following additional requirements:

A. Additions up to 100 square feet shall not exceed 50 square feet of glazing, ~~and~~ the glazing U-value shall not exceed 0.75 and the glazing Solar Heat Gain Coefficient shall not exceed the value specified in Alternative Component Package D [Tables 1-Z1 through 1-Z16] ; or

. . .

Fenestration Alterations, Section 152(b)1.

A. Alterations that add fenestration area to a building shall be limited to a maximum 0.75 U-value and the Solar Heat Gain Coefficient for new fenestration products as specified in Alternative Component Package D [Tables 1-Z1 through 1-Z16].

. . .

NOTE: Fenestration products repaired or replaced, not as part of an alteration, need not comply with the U-value and Solar Heat Gain Coefficient requirements applicable to alterations.

K. Miscellaneous Changes

Compliance Methods, Section 151(d)

(d) **Compliance Methods for Performance Standards**. Compliance with the energy budget requirements of Section 151 (a) 3 and (b) must be demonstrated either by:

1. ~~Using a point system approved by the commission including any computer programs approved by the executive director that are based on an approved point system; or~~

~~2.~~ Using the compliance version of the commission's Public Domain Computer Program or any alternative calculation method approved by the commission for use in complying with Section 151 (a) and (b).

Update NFRC References, Section 10-111 and Appendix 1-A

(a) **Labeling Requirements.**

1. **Temporary labels.** . . .

B. If the product U-value rating is derived from the NFRC Rating Procedure, then placing the words "Manufacturer stipulates that this rating was determined in accordance with applicable NFRC procedures" followed by the rating procedure number and certified U-value on the temporary label meets the requirement of paragraph 1.

The "NFRC Rating Procedure" as used in this subparagraph B means the National Fenestration Rating Council's ~~NFRC 100-91: Procedure for Determining Fenestration Product Thermal Properties (currently limited to U-values) (1991), or~~ NFRC 100: Procedure for Determining Fenestration Product U-factors (1997) also known as "NFRC 100", incorporated herein by reference.

2. **U-value and SHGC.** Fenestration products shall:

A. Be certified for overall U-values as rated in accordance with the National Fenestration Rating Council's ~~NFRC-100-91 (1991), or~~ NFRC 100 (1997) and be certified for overall SHGC, as rated in accordance with the National Fenestration Rating Council's NFRC 200 (1995), incorporated herein by reference, or such values shall be certified in accordance with a default table method set forth in Section 10-111; and

APPENDIX 1-A
STANDARDS REFERENCED IN ENERGY EFFICIENCY REGULATIONS

. . .

ASTM E1918-97	Standard Test Method for Measuring Solar Reflectance of Horizontal and Low Sloped Surfaces in the Field.
ASTM E903-96	Standard Test Method for Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres.
ASTM E408-71(1996)e1	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
ASTM C1371-98	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.

. . .

NATIONAL FENESTRATION RATING COUNCIL

~~NFRC 100-91~~	~~Procedure for Determining Fenestration Product Thermal Properties (currently limited to U-values) (1991)~~
NFRC 100	Procedure for Determining Fenestration Product U-factors (1997)
NFRC 200	Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence (1995)
NFRC 400	Procedure for Determining Fenestration Product Air Leakage (1995)

Available from: National Fenestration Rating Council
1300 Spring Street, Suite ~~200~~500
Silver Spring, Maryland 20910
(301) 589-6372

2. Proposed ACM Approval Manual Changes

A. Overview, Chapter 1

1.1 Summary of ACM Changes

The ACM Approval Manual is updated with each major revision of the low-rise residential Standards. This manual is to be used with the ~~1998~~2001 Standards ~~to be implemented July 1, 1999~~. The major changes between this manual and the 199~~2~~8 manual are summarized below.

1.1.1 Modeling Assumptions

Several changes have been made to the way energy use is calculated in the public domain program, as summarized below.

- Interior ~~Fenestration~~ Shading
- ~~Thermal Mass Defaults~~
- ~~Basement Walls~~
- ~~Thermal Distribution~~ Space Conditioning System Efficiency

  (including a variety of assumptions ~~duct efficiency measures~~ such as air flow, refrigerant charge, fan wattage and efficiency adjusted for California's outdoor operating temperatures~~leakage reduction, ACCA Manual D design specifications, reduced duct surface area~~)
- ~~Infiltration/Ventilation Modeling~~

  ~~(including continuous infiltration reduction, window opening for Indoor Air Quality [IAQ] and shielding class)~~
- ~~Solar Gain Reductions~~
- ~~Water Heating Calculations~~

1.1.2 Standard Design Definition

The definition of the standard design (the custom budget building) has been updated to correspond with the performance levels required by the ~~1998~~2001 Standards.

1.2 ACM Requirements

This chapter presents the general requirements for residential ACMs.

Appropriate inputs for all modeling capabilities are discussed in Chapter 2.

1.2.1 Minimum Modeling Capabilities

Minimum modeling capabilities must be included in all ACMs. If a candidate ACM does not have all of these capabilities, then it cannot be approved for compliance. The minimum modeling capabilities are summarized below:

- Conduction gains and losses through opaque and fenestration surfaces.
- Infiltration gains and losses
- Solar gains through glazing including the effects of internal shading devices, external shading devices and fixed overhangs.

- Natural ventilation cooling and natural ventilation for Indoor Air Quality (IAQ).
- Mechanical Ventilation for IAQ.
- Thermal mass effects to dampen temperature swings.
- Space conditioning equipment efficiency and distribution systems.
- Water heating equipment efficiency and distribution systems.
- Radiant Barriers
- Cool Roofs

. . .

B. Standard Reports, Chapter 2

2.1 Certificate of Compliance (CF-1R)

…

Fenestration Surfaces. The term "fenestration" is used to refer to an assembly of components consisting of frame and glass or glazing materials. According to the standards, fenestration includes "any transparent or translucent material plus frame, mullions, and dividers, in the envelope of a building." Fenestration surfaces include windows, skylights and glazing in doors or other transparent or translucent surfaces. This listing reports information about each fenestration surface. One row is to be included in the listing for each unique fenestration condition. When compliance is for all orientations, the building facade orientations shall be reported for the case with the "front" facing north or the orientation shall be reported as "*Any*", and the *Special Features and Modeling Assumptions* listings must also indicate that compliance is for all orientations.

FENESTRATION SURFACES

Fenestration #/Type/Orien	Orien-tation	Area (ft^2)	Fenes-tration U-value	Fenestration SHGC	~~Interior Shading Att.~~	Exterior Shading Att.	Over-hang /Fins
1 Wdw Front	N	10	0.65	0.70			None
2 Wdw Front	NW	40	0.65	0.60	~~Roller-shade~~		None
3 Wdw Front	N	8	1.23	1.23	~~Blindsna~~	na	None
4 Wdw Left	W	110	0.65	0.65		Shade-screen	None
5 Wdw Back	S	50	0.65	0.65			Ovhg
6 Wdw Back	S	8	1.23	1.23			None
7 Wdw Right	E	85	0.65	0.65			None
8 Sky Back	S	8	1.23	1.23			None
9 Sky Horz	na	22	1.23	1.23			None

- *Fenestration Surface: Num/Type/Loc (#/text/prescribed descriptor). Num* is a unique number assigned by the user to each fenestration item in the fenestration surfaces list (see Computer Method Summary; C-2R). The type

is Wdw (window) Dr (door) or Sky (skylight). *Loc* is the location of the surface with respect to the front of the building (Front, Back, Left, Right or na).

- *Orientation* (prescribed descriptor) is reported here as the nearest 22.5° compass point in parenthesis (N, NNE, NE, ENE etc.). *Orientation* may also be reported to the nearest degree (0°-360°). When compliance is for all orientations, orientation may be listed as *All* or only the *Loc* need be reported or *Orientation* may be reported with Front facing North.
- *Area (ft^2).* The rough frame area of the fenestration in square feet.
- *U-value*. The rated U-value of the fenestration product, in Btu/h-ft^2-°F, including air films. Calculated fenestration U-values are rounded and reported to 2 digits to the right of the decimal.
- *Fenestration SHGC:* The Solar Heat Gain Coefficient (SHGC) for this fenestration system typically the glazing plus the frame. This value corresponds to the rated value reported on a Commission-approved label, a Commission default value reported on a manufacturer's label, or a Commission default value for a carpenter's window.
- ~~*Interior Shading Att.:* A verbal description of the interior shading attachment if an attachment other than the default drapery is proposed. Interior shades recognized by the standards include default draperies, blinds (all colors and styles), and opaque roller shades. Translucent roller shades have higher SHGCs than opaque roller shades hence they are modeled as default draperies. The Solar Heat Gain Coefficients (SHGCs) for these attachments shall be taken from the attachments listed in Table 2-1 below.~~

~~The allowed solar heat gain coefficient of the attachments shown in Table 2-1 are based on the shading performance of those products in combination with 1/8" single pane clear glass and metal framing. "*Standard*" (Default Interior Shade - Draperies) or " " (a blank field) must automatically appear in this field when no special interior shading device is included in the building plans.~~

~~Table 2-1 Allowed Interior Shading Devices and Recommended Descriptors~~

~~Recommended Descriptor~~	~~Interior Shading Attachment Reference~~	~~Solar Heat Gain Coefficient before 1/1/2002~~	~~Solar Heat Gain Coefficient after 1/1/2002~~
~~*Standard*~~	~~Draperies or No Special Interior Shading - Default Interior Shade~~	~~0.68~~	~~0.68[1]~~
~~*Blind*~~	~~Venetian Blind, Vertical Blind or MiniBlind~~	~~0.47~~	~~0.47~~
~~*OpRollShd*~~	~~Opaque Roller Shades~~	~~0.47~~	~~0.68~~
~~*None*[2]~~	~~No Interior Shading - Only for Skylights (Fenestration tilt <60 degrees)~~	~~1.00~~	~~1.00~~

~~Note (general): No other interior shading devices or attachments are given credit for compliance with the building efficiency standards.~~

~~Note 1: Default drapery shading shall be assumed whenever no other interior shading is specified for a window. Output shall note that although *Standard* is specified, a drapery is modeled but is not required to be installed and present at final inspection . Output shall note for any interior shading device other than drapery that it must be installed and present at final inspection.~~

~~Note 2: *None* is the default for fenestration tilted less than 60 degrees from horizontal (skylights) and is only allowed for fenestration tilted less than 60 degrees from horizontal (skylights)., i.e. *None* is not an interior shading option for ordinary vertical windows.~~

. . .

HVAC Systems. This listing provides data on the heating and cooling systems in the building. These data are identical to those in the Computer Method Summary (Report C-2R) under "HVAC Systems" described on Page 37

HVAC SYSTEMS

System Name	System Type	TXV	Minimum Equipment Efficiency	Distribution Type and Location	Duct R-value
Zone=Living					
LowerHeat	GasFurnace	N/A	0.78 AFUE	DuctsCrawl	4.2
LowerAC	AirCond-Split	Yes	10.0 SEER	DuctsCrawl	4.2
Zone=Sleep					
UpperHeat	Electric	N/A	1.00 COP	Baseboard	
UpperAC	AirCond-Split	No	10.0 SEER	DuctsAttic	4.2

- *System Name (text):* A unique name for the HVAC system
- *System Equipment (recommended descriptor):* The type of HVAC equipment. This is specified separately from the distribution type.

  Permissible equipment types: Listed in Tables 2-~~3~~2 and 2-~~3~~.4.

  In the case of *CombHydro* heating, the name of the water heating system should be identified in the previous column. When the proposed house is not air conditioned, the entry should be

NoCooling. If more than one type of equipment is specified, each must be listed on separate rows.

- *TXV:* Whether a thermostatic expansion valve is included for ducted central systems. Six equipment types can be modeled with a TXV. They are: *SplitAirCond, PkgAirCond, LrgPkgAirCond, SplitHeatPump, PkgHeatPump, LrgPkgHeatPump.* See Table 2-3 for a description of equipment.

Table 2-~~3~~2 HVAC Heating Equipment Descriptors

Recommended Descriptor	Heating Equipment Reference
CntrlFurnace	Gas- or oil-fired central furnaces, propane furnaces or heating equipment considered equivalent to a gas-fired central furnace, such as wood stoves that qualify for the wood heat exceptional method. Gas fan-type central furnaces have a minimum AFUE=78%. Distribution can be gravity flow or use any of the ducted systems. [Efficiency Metric: AFUE]
Heater	Non-central gas- or oil-fired space heaters, such as wall heaters floor heaters or unit heater. Equipment has varying efficiency requirements. Distribution is ductless and may be gravity flow or fan-forced.[Efficiency Metric: AFUE]
Boiler	Gas or oil boilers. Distribution systems can be *Radiant*, *Baseboard* or any of the ducted systems. *Boiler* may be specified for dedicated hydronic systems. Systems in which the boiler provides space heating and fires an indirect gas water heater (*IndGas*) may be listed as *Boiler/CombHydro Boiler* and must be listed under "Equipment Type" in the HVAC Systems listing. [Efficiency Metric: AFUE]
SplitHeatPump	Heating side of central split system heat pump heating systems. Distribution system must be one of the ducted systems. [Efficiency Metric: HSPF]
PkgHeatPump	Heating side of central packaged heat pump systems. Central packaged heat pumps are heat pumps in which the blower, coils and compressor are contained in a single package, powered by single phase electric current, air cooled, rated below 65,000 Btuh. Distribution system must be one of the ducted systems. [Efficiency Metric: HSPF]
LrgPkgHeatPump	Heating side of large packaged units rated at or above 65,000 Btu/hr (heating mode). Distribution system must be one of the ducted systems These include water source and ground source heat pumps. [Efficiency Metric: COP]
GasHeatPump	Heating side of a gas-fired heat pump. The efficiency is set at COP 1.18/18.73.
RoomHeatPump	Heating side of non-central room air conditioning systems. These include small ductless split system heat pump units and packaged terminal (commonly called "through-the-wall") units. Distribution system must be *DuctIndoor*. [Efficiency Metric: COP]
Electric	All electric heating systems other than space conditioning heat pumps. Included are electric resistance heaters, electric boilers and storage water heat pumps (air-water) (StoHP). Distribution system can be *Radiant*, *Baseboard* or any of the ducted systems. [Efficiency Metric: HSPF]
CombHydro	Water heating system can be storage gas (*StoGas*, *LgStoGas*), storage electric (*StoElec*) or heat pump water heaters (*StoHP*). Distribution systems can be *Radiant*, *Baseboard*, or any of the ducted systems and can be used with any of the terminal units (*FanCoil*, *RadiantFlr*, *Baseboard*, and *FanConv*).

Table 2-~~4~~3-HVAC Cooling Equipment Descriptors

Recommended Descriptor	Cooling Equipment Reference
NoCooling	Entered when the proposed building is not air conditioned or when cooling is optional (to be installed at some future date). Both the *Standard Design* equivalent building and the proposed design use the same default system (refer to sections 3 and 4). [Efficiency Metric: SEER]
SplitAirCond	Split air conditioning systems. Distribution system must be one of the ducted systems. [Efficiency Metric: SEER]
PkgAirCond	Central packaged air conditioning systems less than 65,000 Btuh cooling capacity. Distribution system must be one of the ducted systems. [Efficiency Metric: SEER]
LrgPkgAirCond	Large packaged air conditioning systems rated at or above 65,000 Btu/hr (cooling capacity). Distribution system must be one of the ducted systems. [Efficiency Metric: EER]
RoomAirCond	Non-central room air conditioning cooling systems. These include small ductless split-system air conditioning units and packaged terminal (commonly called "through-the-wall") air conditioning units. Distribution system must be *DuctIndoor*. [Efficiency Metric: EER]
SplitHeatPump	Cooling side of split heat pump systems. Distribution system must be one of the ducted systems. [Efficiency Metric: SEER<65,000 Btu/hr EER>65,000 Btu/hr]
PkgHeatPump	Cooling side of central single-packaged heat pump systems with a cooling capacity less than 65,000 Btuh. Distribution system must be one of the ducted systems. [Efficiency Metric: SEER]
LrgPkgHeatPump	Cooling side of large packaged heat pump systems rated at or above 65,000 Btu/hr (cooling capacity). Distribution system must be one of the ducted systems. [Efficiency Metric: EER]
GasHeatPump	Cooling side of a gas-fired heat pump. The efficiency is set at COP 1.38/21.81.
RoomHeatPump	Cooling side of non-central, room heat pump systems. These include small ductless split-system air conditioning units and packaged terminal (commonly called "through-the-wall") units. Distribution system must be *DuctIndoor*. [Efficiency Metric: EER]
EvapDirect	Direct evaporative cooling systems. The SEER is set to 11.0. The default distribution system location is *DuctAttic*; evaporative cooler duct insulation requirements are the same as those for air conditioner ducts. [Efficiency Metric: SEER]
EvapIndirDirect	Indirect-direct evaporative cooling systems. The SEER is set to 13.0. The default distribution system location is *DuctAttic*; evaporative cooler duct insulation requirements are the same as those for air conditioner ducts. [Efficiency Metric: SEER]

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Table 2-~~3~~4 HVAC Distribution Type and Location Descriptors

Recommended Descriptors	HVAC Distribution Type and Location Reference
Ducted Systems	Fan-powered, ducted distribution systems that can be used with most heating or cooling systems. When ducted systems are used with furnaces, boilers, or combined hydronic/water heating systems the electricity used by the fan shall be calculated using the methods described later in this manual. R-value must be specified in "Duct R-value" column when a ducted system is specified
DuctsAttic	Ducts located overhead in the unconditioned attic space
DuctsCrawl	Ducts located underfloor in the unconditioned crawl space
DuctsCVC	Ducts located underfloor in a controlled ventilation crawl space
DuctsGarage	Ducts located in an unconditioned garage space.
DuctsBasemtl	Ducts located in an unconditioned basement space
DuctsInEx12	Ducts located within the conditioned floor space except for less than 12 lineal feet of duct, typically an HVAC unit in the garage mounted on return box with all other ducts in conditioned space.
DuctsInAll	HVAC unit or systems with all HVAC ducts located within the conditioned floor space, such as gas-fired wall furnaces. This category is used also for systems such as wall furnaces having a fan.
DuctsOutdoor	Ducts located in exposed locations outdoors.
Ductless Systems	Ductless radiant or warm/cold air systems using fan-forced or natural air convection and hydronic systems relying upon circulation pumps and fan-forced or natural air convection, and
Furnaces	Heating equipment such as wall and floor furnaces
Radiant	Radiant electric panels or fanless systems used with a boiler, electric or heat pump water heater, or combined hydronic heating equipment.
Baseboard	Electric baseboards or hydronic baseboard finned-tube natural convection systems

2.2 Computer Method Summary (C-2R)

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Fenestration Surfaces. This listing must include information about each fenestration surface in the proposed building. Fenestration surfaces include windows, skylights and glazing in doors or other transparent or translucent surfaces. One row is included in the listing for each unique fenestration condition. ~~This listing must also report a note that the SHGC values for fenestration must be taken from an approved label or from the default table in the standards. Default table values for SHGC can only be used when the ACM automatically selects the default based upon other user inputs for the fenestration.~~ ACMs must restrict users to select from a limited list of ~~interior and~~ exterior shading devices and their associated solar heat gain coefficients (SHGCs), namely, those devices and SHGCs listed in Table 2-1 ~~for interior shading devices and those devices and SHGCs in Table 2-2~~ for exterior shading devices. ACMs shall not allow users to enter custom shading devices nor account for differences in alternative color, density, or light transmission characteristics. ~~Translucent roller shades must be treated as drapes.~~ ACM's are required to calculate, but not report, $SHGC_{open}$ and $SHGC_{closed}$ using 1998 Standards calculation procedures and assumptions.

For buildings that are modeled as multiple thermal zones, the fenestration surfaces shall be grouped for each zone and indicated with a header "Zone = <Zone Name>". The zone name used in the header should be the same as the name used in the table titled "Building Zone Information"

FENESTRATION SURFACES

Fenestration #/Type/Orien	Area (ft^2)	U-Value	Fenes. SHGC	True Az	Tilt	Exterior Shade Type /SHGC	~~Interior Shade Type/SHGC~~
Zone=Living							
1 Wdw Front(N)	70.4	0.65	0.88	0	90		~~Blinds/ 0.47~~
2 Wdw Left(E)	70.4	0.65	0.88	90	90	WveScrn/ 0.39	~~StdDrp/ 0.68~~
Zone=Sleeping							
3 Wdw Back(S)	70.4	0.65	0.88	180	90		~~RllrShd/ 0.47~~
4 Wdw Right(W)	70.4	0.65	0.88	270	90	LvrScrn/ 0.36	~~StdDrp/ 0.68~~

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- ~~*Interior Shade Type/SHGC*. The type of interior shading device and its solar heat gain coefficient from Table 2-1. "*Standard/0.68*" or " ", (no special interior shading or any drapery) must appear when no other interior shading device is included in the building plans and specifications. Output shall indicate that the default devices - in this case draperies - are not required to be installed even if *Standard* appears on an output list. Note that this~~

~~default category now covers all types of draperies including all colors and weave densities. Two other types of interior shading devices may be specified: *Blinds* and *RollrShd* (opaque roller shades). **Translucent roller shades** are classified as **default draperies** (*Standard*). No other interior shading devices or attachments are recognized or given credit in the standards.~~

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HVAC Systems. Information is provided on the type of heating and cooling systems proposed for each zone of the building. Data in the table is organized to accommodate any type of heating or cooling system so some of the information is not applicable for all system types. When the information is not applicable, "na" is reported. Data in this table should be organized first by heating and cooling system. Note that the thermostat type is reported under "Building Zone Information" described above.

For buildings that are modeled as multiple thermal zones, the items shall be grouped for each zone and indicated with a header "Zone = <ZoneName>". The zone name used in the header should be the same as the name used in the table titled "Building Zone Information"

HVAC SYSTEMS

Equipment Type	Minimum Equipment Efficiency (or Water Heating System Name)[1]	Thermostatic Expansion Valve	Distribution Type and Location	Duct R-value
Zone=Living				
Furnace	0.78 AFUE	N/A	DuctsCrawl	4.2
AirCond-Split	10.0 SEER	Yes	DuctsCrawl	4.2
Zone=Sleep				
CombHydro	Upper Floors	N/A	Baseboard	na.
AirCond-Split	10.0 SEER	No	DuctsAttic	4.2

- *Equipment Type.* The type of heating or cooling equipment. This is specified separate from the distribution type. Required heating equipment and cooling equipment entries are listed in Tables 2-~~7~~2 and 2-3. When the proposed house is not air conditioned, the entry should be NoCooling. If more than one type of equipment is specified, they may be listed on subsequent rows.

[1]"Water Heating System Name" may be omitted from heading, except when combined hydronic systems are used.

~~Table 2-9 - HVAC Equipment Types~~

	~~Heating Equipment~~
~~Furnace~~	~~Can be gas, oil or propane; central or wall unit. Distribution systems can be gravity, or any of the ducted systems.~~
~~Boiler~~	~~Can be gas, oil or propane. Distribution systems can be any of the defined systems. "Boiler" is specified for dedicated hydronic systems.~~
~~HtPumpSplit~~	~~Distribution system must be one of the ducted systems~~
~~HtPumpPckg~~	~~Distribution system must be one of the ducted systems~~
~~Electric~~	~~Includes all electric heating systems other than HtPumpSplit or HtPumpPckg, for instance, electric resistance, electric boilers or hot water heat pumps. Distribution systems can be Radiant, Baseboards or any of the ducted systems~~
~~CombHydro~~	~~Heating system can be storage gas, storage electric or heat pump water heaters. Distribution systems can be fan, radiant or any of the ducted systems.~~
	~~Cooling Equipment~~
~~No cooling~~	~~Entered when the proposed building is not air conditioned~~
~~AirCondSplit~~	~~Distribution system must be one of the ducted systems~~
~~AirCondPackg~~	~~Distribution system must be one of the ducted systems~~
~~HtPumpSplit~~	~~Distribution system must be one of the ducted systems~~
~~HtPumpPackg~~	~~Distribution system must be one of the ducted systems~~

- *Minimum Equipment Efficiency.* The minimum equipment efficiency needed for compliance. The applicable efficiency units should also be reported, for instance AFUE for furnaces and boilers, HSPF for electric heating equipment, and SEER for heat pumps (cooling) and central air conditioners. In the case of combined hydronic heating, the name of the water heating system should be identified. If equipment type is Electric (other than heat pump), an HSPF of 3.413 should be entered, except for radiant systems which use a maximum HSPF of 3.55.
- *Thermostatic Expansion Valve.* The choices for TXV are 'yes' or 'no.' See Section 2.1 for system types for which TXV credit can be claimed.
- *Distribution Type and Location.* The choices for distribution type and location are shown in Table 2-~~10~~5 with a brief discussion of each. ~~—~~Any duct location other than all ducts in the attic (*DuctsAttic)* must also be reported in the *Special Features and Modeling Assumptions* listings AND the *HERS Required Verification* listings on the CF-1R and C-2R forms printed by the ACM.

Table 2-10 - Heating and Cooling Distribution Types and Locations

	Distribution System Type/Location
DuctsAttic DuctsCrawl DuctsGarage DuctsBasemt DuctsCVC DuctsInEx12 DuctsInAll	The fan powered ducted distribution systems can be used with any of the heating and cooling systems. When ducted systems are used with furnaces or boilers, then the electricity used by the fan shall be calculated using the methods described later in this manual. If a ducted distribution system is indicated, then the R-value must be indicated in the next column. "DuctsInEx12" is used for ducted distribution systems where all the main air handler and all but 12 lineal feet or less of ducts and plenums are within conditioned space such as an HVAC unit in a garage adjacent to the conditioned space. For the purpose of determining duct and plenum lengths, the "length" of a plenum return box is the cross diagonal of the box. "DuctsInAll" must have both the HVAC unit and any ducts or plenums located totally within conditioned space. "DuctsInAll" is also used for non-ducted fan systems, such as a wall furnace with fan.
DuctLess	This distribution system is most typical for a wall furnace with no fan and floor furnaces, although some central systems might also be constructed without ducts (distributed fan coil units).
Radiant	A ductless system that can be used with a boiler, electric or combined hydronic heating equipment (with no fan).
Baseboard	A ductless system that can be used with a boiler, electric or combined hydronic heating equipment (with no fan).

The default distribution type and location is a ducted, central system with 100% of the ducts in the attic. If a duct design is specified with duct locations on the plans but without specific duct surface areas (sizes and lengths) specified, a *Special Features and Modeling Assumptions* entry thatwhich specifies the default duct locations that are specified in Section 3.8.34. To use DuctsCrawl or DuctsBsmt, all supply registers must be in the floor and the *Special Features and Modeling Assumptions* listings must indicate that all supply registers are in the floor.

3.C. Standard and Proposed Design, Chapter 3

3.2 Building Physical Configuration

3.2.4 Radiant Barriers

Proposed Design: The ACM must allow the user to input a radiant barrier. The presence of a radiant barrier must be reported in the *Special Features and Modeling Assumptions* listings on the CF-1R and C-2R.

Standard Design: The *Standard Design* shall have a radiant barrier in accordance with Package D requirements.

3.2.4 Cool Roofs

Proposed Design: The ACM must allow the user to input a cool roof. The presence of a cool roof must be reported in the *Special Features and Modeling Assumptions* listings on the CF-1R and C-2R.

Standard Design: The *Standard Design* shall be modeled without a cool roof.

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3.4 Solar Heat Gain Coefficients

Proposed Design: ~~—~~ACMs must require the user to enter the fenestration Solar Heat Gain Coefficient for each window, skylight, or other fenestration system type with a separate area. This requirement may be met by having the user select from a standard list of fenestration systems and sizes or by direct entry for user-defined windows or skylights. In addition, for each window, skylight and fenestration element the ACM must require the user to select an ~~interior and~~ exterior shading treatment from the lists given in Table 3-3~~the tables below~~. The ACM will then determine the overall SHGC for the complete fenestration system based on the fenestration SHGC and the SHGCs assigned to the Commission-approved ~~interior and~~ exterior shading devices and assigned interior shading devices from Tables 3-2 and 3-3.

Standard Design: The *Standard Design* fenestration Solar Heat Gain Coefficients (SHGCs) are determined by the appropriate Package D specifications for the applicable climate zone. Note that the frame type and the presence or absence of muntins or dividers is ~~now~~ irrelevant for the *Standard Design* as~~since the~~ Package D values for $SHGC_{fen}$ and the U-value include the effects of fenestration features such as framing, dividers, and muntins.

3.5 Shading Devices and their Solar Heat Gain Coefficients

Internally, ACMs shall use two values to calculate solar heat gain through windows: $SHGC_{open}$ and $SHGC_{closed}$. $SHGC_{open}$ is the total solar heat gain coefficient of the fenestration and its exterior shading device when the operable interior shading device is open. ~~—~~ $SHGC_{closed}$ is the total solar heat gain coefficient when the interior shading device is closed. $SHGC_{open}$ is the setting that applies when the air conditioner is not operating, which typically is most of the 24-hour period, while ~~—~~$SHGC_{closed}$ applies only for periods when the air conditioner operates. The *Standard Design* values for these SHGCs are shown in Table 3-4 below. $SHGC_{open}$ and $SHGC_{closed}$ are not user specified inputs.

The ACM must require the user to directly or indirectly specify $SHGC_{fen}$ and frame type. The ACM must assign an interior shading device as listed in Table 3-2 and require the user to specify ~~interior and~~ an exterior shading device~~s~~ as ~~the types~~ listed in Table~~s 3-2 and~~ 3-3. The ACMs must calculate the overall SHGC for the fenestration with shading devices as shown in Chapter 4.

For both the *Proposed Design* and the *Standard Design,* all windows are assumed to have ~~some type of interior shading (~~draperies and skylights are assumed to have no interior shading.~~) even if *NoRqmt* is specified for compliance purposes and none are present at final inspection. The ACM Compliance Supplement and the ACM output must indicate that interior shading devices or attachments other than *Drapes* that receive credit for solar heat gain reduction must be present at final inspection.~~ The ACM Compliance Supplement must also explicitly indicate that the ACM automatically gives credit for draperies for all windows ~~that do not use higher performance interior shading devices~~ and that credit is allowed only for one ~~interior shading device and one~~ exterior shading device.~~ The default interior shading is a drapery which is given a fixed Solar Heat Gain Coefficient specified in the standards regardless of the type of drapery that might be installed. That is, no additional credit may be taken due to the color or weave density of draperies.~~

Proposed Design: The ACM must require the user to either accept the default exterior shading device~~s~~ or select from a specific Commission-approved list~~s~~ of~~ interior and~~ exterior shading devices for each fenestration element. The ~~default choice for~~ interior shading device is *Standard* (0.68 SHGC) for windows and *None* (1.0 SHGC) for skylights~~which uses the drapery SHGC of 0.68 specified in the Standards~~. ~~–~~The default choice for exterior shading device is *Standard,* which is assigned an average SHGC of 0.76

Standard Design: ~~–~~The ACM uses the default values for interior and exterior shading devices for the *Standard Design* based on *Standard* for windows and *None* for skylights from Tables 3-2 and 3-3.

Table 3-1 Allowed Interior Shading Devices and Recommended Descriptors

Recommended Descriptor	Interior Shading Attachment Reference	~~Solar Heat Gain Coefficient before 1/1/2012~~	Solar Heat Gain Coefficient ~~after 1/1/2002~~
Standard	Draperies or No Special Interior Shading - Default Interior Shade	~~0.68~~	0.68 *1*
~~*Blind*~~	~~Venetian Blind, Vertical Blind or MiniBlind~~	~~0.47~~	~~0.47~~
~~*OpRollShd*~~	~~Opaque Roller Shades~~	~~0.47~~	~~0.68~~
None *2*	No Interior Shading - Only for Skylights (Fenestration tilt <60 degrees)	~~1.00~~	1.00

Note (general): No other interior shading devices or attachments are allowed credit for compliance with the building efficiency standards.

Note 1: Standard~~Default drapery~~ shading shall be assumed for all fenestration with a tilt greater than or equal to 60 degrees from horizontal~~whenever no other interior shading is specified for a window. Output shall note that although *Standard* is specified, a drapery is modeled but it is not required to be installed and present at final inspection. Output shall note for any interior shading device other than drapery that it must be installed and present at final inspection.~~

Note 2: *None* is the default interior shading device in the standard and proposed design for fenestration tilted less than 60 degrees from horizontal (skylights) and is only allowed for fenestration tilted less than 60 degrees from horizontal (skylights)., i.e. *None* is not an interior shading option for ordinary vertical windows.

Table 3-2 Allowed Exterior Shading Devices and Recommended Descriptors

Recommended Descriptor	Exterior Shading Device Reference	Solar Heat Gain Coefficient
Standard	Bug Screen or No Shading - Default Bugscreens are modeled	0.76
WvnScrn	Woven SunScreen (SC<0.35)	0.30
LvrScrn	Louvered Sunscreen	0.27
LSASnScrn	LSA Sunscreen	0.13
RlDwnAwng	Roll-down Awning	0.13
RlDwnBlnds	Roll -down Blinds or Slats	0.13
None [1]	For skylights only - No exterior shading	1.00

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3.8 Heating and Cooling System

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3.8.2 Cooling Equipment

Proposed Design: ACMs must be able to model the basic types of cooling equipment listed in Table 2-43. ACMs must require the user to enter the basic information to model the energy use of these pieces of equipment. At the minimum this includes some type of seasonal distribution system efficiency for cooling, identification of whether the cooling system is ducted or non-ducted and central or non-central. If the cooling system is non-ducted non-central, the ACM must require the user to select the type and size of the equipment from those shown in Table 3-6. The efficiencies of all cooling equipment and distribution systems are converted to source seasonal energy efficiency ratios (SSEER), as shown in Equations 3.1c, 3.2c and 3.3c.

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Standard Design: If a packaged ducted central air conditioner (*PkgAirCond* or *LrgPkgAirCond*) or ducted central packaged heat pump (*PkgHeatPump* or *LrgPkgHeatPump*) is used for the *Proposed Design*, the cooling system used in the *Standard Design* building shall be a single package air conditioner (*PkgAirCond* or *LrgPkgAirCond*) with an SEER (seasonal energy efficiency ratio) of 9.7. Otherwise, the cooling system for the *Standard Design* building with a central system shall be a split system central air conditioner *(SplitAirCond)* with an SEER of 10.0. For non-ducted non-central cooling equipment, the efficiencies shall be as shown in Table 3-6 for the type and size in the *Proposed Design* where the size may be a user input or shall

default to 24 Btu per hour per square foot of conditioned floor area. In the case of *NoCooling* for the *Proposed Design*, the cooling system for the *Standard Design* building shall be a split system air conditioner (*SplitAirCond*) with an SEER of 10.0. – When a *Proposed Design* uses both a split system air conditioner and another type of air conditioner, the *Standard Design* SEER shall be a conditioned floor area weighted average of the equivalent SEER of the cooling equipment. The efficiencies of all cooling equipment and distribution systems are converted to source seasonal energy efficiency ratios (SSEER), as shown in Equations 3.1c, 3.2c and 3.3c.

Seasonal air distribution efficiencies ($\eta_{dist,\ seasonal}$) for the *Proposed Design* and the *Standard Design* shall be calculated using the procedures and algorithms in Appendix F. The seasonal distribution efficiencies for the *Standard Design* shall be calculated using the defaults specified in Appendix F. The seasonal distribution system efficiency shall be calculated using the seasonal delivery effectiveness ($DE_{seasonal}$), the equipment efficiency factor (F_{equip}), and the thermal recovery factor (F_{recov})

Source seasonal energy efficiency ratios for the *Proposed Design* and the *Standard Design* shall be calculated as shown in Equations 3.1c, 3.2c and 3.3c.

$$\eta_{dist,\,seasonal} = 0.98 \times DE_{seasonal} \times F_{equip} \times F_{recov} \qquad \text{Equation 3.1c}$$

$$SSEER_{central,\,ducted} = SEER_{temperature} \times F_{install} \times F_{TXV} \times \eta_{dist,\,seasonal} \qquad \text{Equation 3.2c}$$

$$SSEER_{other} = SEER \times \eta_{dist,\,seasonal} \qquad \text{Equation 3.3c}$$

The temperature adjusted SEER ($SEER_{temperature}$) adjusts the performance of the cooling equipment at typical outdoor air temperatures by climate zone depending on the SEER rating. For *SplitAirCond, PkgAirCond, SplitHeatPump, PkgHeatPump*, $SEER_{temperature}$ shall be interpolated from Table 3.6c. For all other central ducted equipment, $SEER_{temperature}$ shall be equal to the EER rating.

Table 3.6c -- Temperature adjusted SEER ($SEER_{temperature}$) by Climate Zone

CZ	SEER 10	SEER 11	SEER 12	SEER 13	SEER 14	SEER 15	SEER 16	SEER 17	SEER 18
1	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
2	9.71	10.57	11.52	12.25	12.96	13.65	14.34	15.00	15.66
3	9.75	10.63	11.59	12.37	13.13	13.89	14.63	15.36	16.08
4	9.75	10.63	11.59	12.37	13.13	13.89	14.63	15.36	16.08
5	9.91	10.87	11.86	12.78	13.70	14.61	15.53	16.44	17.34
6	9.98	10.96	11.96	12.94	13.92	14.90	15.88	16.85	17.83
7	9.93	10.90	11.89	12.83	13.77	14.71	15.65	16.58	17.52
8	9.62	10.44	11.38	12.05	12.70	13.34	13.97	14.60	15.21
9	9.41	10.14	11.04	11.53	12.00	12.45	12.89	13.31	13.72
10	9.23	9.88	10.76	11.11	11.44	11.76	12.07	12.36	12.64
11	9.16	9.78	10.64	10.94	11.22	11.48	11.74	11.99	12.22
12	9.22	9.87	10.74	11.08	11.41	11.72	12.01	12.29	12.56
13	9.11	9.72	10.57	10.83	11.08	11.31	11.53	11.74	11.95
14	8.85	9.35	10.16	10.24	10.31	10.38	10.45	10.51	10.58
15	8.87	9.36	10.18	10.26	10.34	10.41	10.48	10.54	10.61
16	9.70	10.56	11.51	12.24	12.97	13.68	14.39	15.09	15.79

The installation factor ($F_{install}$), which adjusts for typical installation practice where refrigerant charge and airflow are not at design values, shall be 0.852.

The thermostatic expansion valve (TXV) factor (F_{TXV}), which adjusts the system performance to account for the presence of a TXV, shall be 1.0 for systems without a TXV. For systems with a TXV, the thermostatic expansion valve factor shall be 1.07 for duct systems designed according to ACCA Manual D and 1.11 for all other duct systems

3.8.3 Thermostatic Expansion Valves

Proposed Design: The ACM must allow the user to enter a central ducted cooling system with a thermostatic expansion valve (TXV). The presence of a TXV requires verification by the HERS rater and must be reported in the *Special Features and Modeling Assumptions and HERS Required Verification* listings on the CF-1R and C-2R.

Standard Design: If a ducted central air conditioner or heat pump (*PkgAirCond, LrgPkgAirCond, SplitAirCond* or *SplitHeatPump*) is used for the *Proposed Design* in accordance with Package D, the cooling system used in the *Standard Design* building shall be equipped with a thermostatic expansion valve.

Adjustments to the source seasonal energy efficiency ratio due to thermostatic expansion valves are described in section 3.8.2

4.D. Modeling Assumptions and Algorithms, Chapter 4

4.4 Shading Calculations

4.4.1 Interior Shading and Exterior Sunscreen Operation

Standard Design & ***Proposed Design***: The standard assumptions for operation of interior shading devices and sunscreens shall apply to both the *Standard Design* run and the *Proposed Design* run.

~~Internal shading devices, such as d~~Draperies ~~and blinds,~~ are assumed to be closed only for hours when the air conditioner operates. To approximate this affect during transitions between periods of operation and non-operation, ACMs may assume that the internal device remains closed for the hour following the period of air conditioner operation. As soon as that hour passes, the internal shading device shall be opened. The internal device shall be either totally open or totally closed for any given hour.

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4.4.2 Solar Heat Gain Coefficients

Solar Heat Gain Coefficients shall be determined according to Chapter ~~2 and~~ 3 of this manual. ACMs use two values for setting the Solar Heat Gain Coefficient of shading devices: "$SHGC_{open}$ " and "$SHGC_{closed}$." ~~—~~"$SHGC_{open}$ " ~~-~~applies when the air conditioner is not in operation (off) and "$SHGC_{closed}$ " applies when the air conditioner is in operation. ~~–~~The ACM user shall not be allowed to enter values for $SHGC_{open}$ and $SHGC_{closed}$. These values must be automatically calculated from the specification of the SHGC for the fenestration ($SHGC_{fen}$), the exterior shade and the interior shade as described below. ~~—~~ACMs shall forbid users from direct entry of SHGCs for interior and exterior shading devices.~~—~~ The ACM must automatically determine these values from the user's choices of ~~interior and~~ exterior shading devices and from the assumption that vertical glazing has a drapery and non-vertical (skylight) glazing has no interior shading device.

There are ~~only~~ a limited set of shading devices with fixed prescribed characteristics that are ~~allowed to be~~ modeled in the performance approach. These devices and their associated fixed Solar Heat Gain Coefficients are ~~given~~ listed in ~~Tables 2-1 and 2-2 and are repeated below in~~ Tables ~~4-4~~3-2 and ~~4-5~~3-3. ~~Table 4-4 gives the allowed interior shading devices and Table 4-5 gives the allowed exterior shading devices.~~

Table 4-4 Allowed Interior Shading Devices and Recommended Descriptors

Recommended Descriptor	Interior Shading Attachment Reference	Solar Heat Gain Coefficient before 1/1/2002	Solar Heat Gain Coefficient after 1/1/2002
Standard	Draperies or No Special Interior Shading -- Default Interior Shade	0.68	0.68[1]
Blind	Venetian Blinds, Vertical Blinds or MiniBlinds	0.47	0.47
OpRollShd	Opaque Roller Shades	0.47	0.68
None [2]	No Interior Shading - Only for Skylights (Fenestration Tilt < 60 degrees)	1.00	1.00

Note (general): No other interior shading devices or attachments are allowed credit for compliance with the building efficiency standards.

Note 1: Default drapery shading shall be assumed whenever no other interior shading is specified for a window. Output shall note that although *Standard* is specified, a drapery is modeled but it is not required to be installed and present at final inspection. Output shall note for any interior shading device other than drapery that it must be installed and present at final inspection.

Note 2: *None* is the default for fenestration tilted less than 60 degrees from horizontal (skylights) and is only allowed for fenestration tilted less than 60 degrees from horizontal (skylights)., i.e. *None* is not an interior shading option for ordinary vertical windows.

Table 4-5 Allowed Exterior Shading Devices and Recommended Descriptors

Recommended Descriptor	Exterior Shading Device Reference	Solar Heat Gain Coefficient
BugScrn	Bug Screen or No Shading - Default Bug Screens are modeled	0.76
WvnScrn	Woven SunScreen (SC<0.35)	0.30
LvrScrn	Louvered Sunscreen	0.27
LSASnScrn	LSA Sunscreen	0.13
RlDwnAwng	Roll-down Awning	0.13
RlDwnBlnds	Roll -down Blinds or Slats	0.13
None [1]	For skylights only - No exterior shading	1.00

Note 1: *None* is the default for fenestration tilted less than 60 degrees from horizontal (skylights) and is only allowed for fenestration tilted less than 60 degrees from horizontal (skylights)., i.e. *None* is not an interior shading option for ordinary vertical windows.

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4.19 Duct Efficiency

The Commission has approved algorithms and procedures for determining duct and HVAC distribution efficiency. Details are presented in Appendix F.

There are two calculation procedures to determine seasonal air distribution efficiency using either 1) default input assumptions or 2) diagnostic measurement values. Air distribution efficiencies for heating and cooling shall be calculated separately. The ACM shall require the user to choose values for the following parameters to calculate seasonal duct efficiencies. The ACM shall use the defaults shown in [brackets] for the *Standard Design* and for the *Proposed Design* or as specifed when the user does not enter a specific value for these parameters or for all proposed designs of dwellings that are not low-rise, single-family dwellings[2]. ~~The defaults must also be used for the *Proposed Design* whenever building cavities such as plenums and platform returns are used in lieu of ductwork in some parts of the HVAC air supply or return system~~:

1. Location of the duct system [ducts in the attic]
2. Insulation level of ducts [R 4.2]
3. The surface area of ducts or separate supply and return surface areas for diagnostic verification. [27% of conditioned floor area (CFA) for supply duct surface area; 5% CFA for return duct surface area in single story dwellings and 10% CFA for return duct surface area in dwellings with two or more stories] or the measured reduced surface area of supply ducts in conjunction with ACCA Manual D design and measured verified fan flow consistent with the ACCA Manual D design.
4. the leakage level of the duct system [~~22%~~6% of fan flow for *Standard Design*, 22% of fan flow for *Proposed Design*]. Two values are possible for the proposed design: 22%~~the default~~ or 6% of fan flow if measured and verified at no more than 6% of fan flow.
5. ACCA manual D design, duct layout and system fan flow [No] –This requires that engineering calculations and a duct layout have been prepared as part of the building plans and that system fan flow specified in those calculations be diagnostically verified by a HERS rater.
6. Designation for systems with less than 12 feet of duct outside conditioned space [No].
7. Attic duct efficiency with radiant barrier in accordance with Package D requirements.

[2] All proposed designs ~~except those using building cavities, such as plenums or platform returns, in lieu of ductwork~~ may model additional insulation (R>4.2) for ducts when installed. The R-value modeled must be the minimum installed insulation level for the entire duct system except as noted in Appendix F even though part of the ducts may serve ~~no~~unmodeled dwellings or spaces.

When any duct efficiency credit is claimed beyond the default assumptions that requires diagnostic testing or verification by a HERS rater or the local enforcement agency, i.e. when non-default values (except HVAC equipment capacities) are used to determine duct efficiency, the leaks in the air distribution system connections shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands and this requirement must be specified in the *Special Features and Modeling Assumptions* listings and the *HERS Required Verification* listings on the CF-1R and the C-2R.

The ACM shall automatically use the following values from the description of the *Proposed Design* when calculating the distribution system efficiency:

- Number of stories
- Building Conditioned Floor Area
- Building Volume
- Floor- Type
- Presence of attic radiant barrier~~s~~ or cool roofs
- Presence of insulation between floor above crawlspace or unconditioned basement, and on or within crawlspace or basement walls adjacent to outside conditions or the ground below
- Outdoor summer and winter design temperatures for each climate zone

When more than one HVAC system serves the building or dwelling, the HVAC distribution efficiency is determined for each system and an conditioned floor area-weighted average seasonal efficiency is determined based on the inputs for each of the systems.

When an existing HVAC system is extended to serve an addition, the default assumptions for duct and HVAC distribution efficiency must be used for both the *Proposed Design* and the *Standard Design*. However, when a new, high efficiency HVAC distribution system is used to serve the addition or the addition and the existing building, that system may be modeled to receive energy credit subject to diagnostic testing and verification of proper installation by a HERS rater.

4.24 Radiant Barriers

Standard Design: The *Standard Design* ~~does not have or use~~ has a radiant barrier~~s~~ in accordance with Package D requirements.

Proposed Design: ~~Energy credit for radiant barriers may be used with approved 1998 alternative calculation methods (ACMs). Approved ACMs must be able to model radiant barriers. The reference method models r~~Radiant barriers are modeled by calculating ceiling U-value modifiers that are functions of the ceiling insulation and the season and by using different seasonal attic temperatures for attics with radiant barriers which result in better HVAC distribution efficiencies for ducts in the attic below a radiant barrier.

Radiant barriers must meet specific eligibility and installation criteria to be modeled by any ACM and receive energy credit for compliance with the energy efficiency standards for low-rise residential buildings.

- The emissivity of the radiant barrier must be less than or equal to 0.05 as tested in accordance with ASTM Test Method C-1371-97.
- Installation must be in conformance with ASTM C-1158-90 (Standard Practice For Use and Installation Of Radiant Barrier Systems (RBS) In Building Construction.), ASTM C-727-90 (Standard Practice For Installation and Use Of Reflective Insulation In Building Constructions.), ASTM 1313-95 (Standard Specification for Sheet Radiant Barriers for Building Construction Applications), and ASTM C-1224-93 (Standard Specification for Reflective Insulation for Building Applications) and the radiant barrier must be securely installed in a permanent manner with the shiny side facing down toward the attic floor. Moreover, radiant bariers must be installed to the roof truss/rafters (top chords) in any of the following methods, with the material:

    1. Draped over the truss/rafter (the top chords) before the upper roof decking is installed.
    2. Spanning between the truss/rafters (top chords) and secured (stapled) to each side.
    3. Secured (stapled) to the bottom surface of the truss/rafter (top chord). A minimum air space must be maintained between the top surface of the radiant barrier and roof decking of not less than 1.5 inches at the center of the truss/rafter span.
    4. Attached [laminated] directly to the underside of the roof decking. The radiant barrier must be laminated and perforated by the manufacturer to allow moisture/vapor transfer through the roof deck.

    In addition, the radiant barrier must be installed to cover all gable end walls and other vertical surfaces in the attic.

- The attic must be ventilated to:

    1. conform to manufacturer's instructions.
    2. provide a minimum free ventilation area of not less than one square foot of vent area for each 150 square feet of attic floor area.
    3. provide no less than 30 percent upper vents.
    4. have a minimum gap of 3.5 inches provided at the bottom of the radiant barrier and at the top of the ceiling insulation (except for method 4 above).
    5. have a minimum of six (6) inches (measured horizontally) left at the roof peak to allow hot air to escape from the air space between the roof decking and the top surface of the radiant barrier (except for method 4 above).

(Ridge vents or gable end vents are recommended to achieve the best performance. The material should be cut to allow for full air flow to the venting.)

- The product must meet all requirements for California certified insulation materials [radiant barriers] of the Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation as indicated in the *Consumer Guide and Directory of Certified Insulation Products*.

The use of a radiant barrier and the criteria specified above shall be listed in the *Special Features and Modeling Assumptions* listings of the CF-1R and C-2R and described in detail in the ACM Compliance Supplement.

For the heating season, Equation 4.46 is the expression for the U-value modifier; for the cooling season, Equation 4.47. —To determine the U-value for a ceiling with a radiant barrier, multiply the U-value of the ceiling assembly without the radiant barrier times the U-value modifier. The U-value modifiers are calculated from equations 4.46 and 4.47.

For installed insulation greater than R-8:

$$UvalMod_{heating} = (-11.404 \times U^2) + (0.21737 \times U) + 0.92661 \qquad \text{Equation 4.46}$$

$$UvalMod_{cooling} = (-58.511 \times U^2) + (3.22249 \times U) + 0.64768 \qquad \text{Equation 4.47}$$

Otherwise these modifiers are 1.0.

4.25 Cool Roofs

Standard Design: The *Standard Design* does not have a cool roof.

Proposed Design: Cool roofs are assumed to have an impact equal to the cooling savings for radiant barriers. The calculations are the same as described in section 4.24 except that $UvalMod_{heating}$ (equation 4.26) is assigned a value of 1.0. In the event that both a cool roof and radiant barrier is specified, there is no credit for the cool roof.

Cool roofs must meet specific eligibility and installation criteria to receive energy credit for compliance as described in the standards. In general, the solar reflectance must be 0.4 or higher for tile roofs or 0.7 or higher the other roof materials; and the emittance must be 0.75 or higher. The use of a cool roof shall be listed in the *Special Features and Modeling Assumptions* listings of the CF-1R and C-2R and described in detail in the ACM Compliance Supplement.

4.2~~5~~6 No Cooling

Standard Design: ~~–~~The *Standard Design* has a cooling system as described in Section 3.8.2. for a central ducted cooling systems the same as the *Proposed Design*.

Proposed Design: Where no air conditioning system is proposed for use, the *Proposed Design* is required to model a split system air conditioner with an SEER of 10.0 with R-4.2 ducts located in the attic with default duct characteristics and a thermostatic expansion valve in accordance with Package D.

E. Minimum Capabilities Tests

5. Minimum Capabilities Tests

Details and number of additional tests to be determined.

F. Optional Capabilities Tests

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G. HERS Verification and Diagnostic Procedures, Chapter 7

7. Home Energy Rating Systems (HERS) Required Verification And Diagnostic Testing

7.1 California Home Energy Rating Systems

The Commission is required to regulate home energy rating system (HERS) providers in California. It will soon be proposing the adoption of such regulations. When adopted, these regulations will appear in the California Code of Regulations, Title 20, Chapter 4, Article 8, Sections 1670-1676). Approved HERS providers will be authorized to certify raters and maintain quality control over ratings. Ratings will be based on visual inspection and diagnostic testing of the physical characteristics and energy efficiency features of ~~house~~dwelling units, as constructed. When the term "dwelling unit" is used in reference to Home Energy Rating Systems (HERS) Required Verification and Diagnostic Testing applied to multifamily buildings, it shall mean each dwelling unit within each multifamily building project. When the term "building owner" is used in this Chapter, it shall mean homeowner or multifamily building owner.

When compliance documentation indicates field verification and diagnostic testing of specific energy efficiency ~~improvements~~ measures as a condition for complying with ~~those improvements to qualify for~~ Title 24 ~~compliance credit~~, an approved HERS provider and certified HERS rater shall be used to conduct the field verification and diagnostic testing. HERS providers and raters shall be considered special inspectors by building departments, and shall demonstrate competence, to the satisfaction of the building official, for the visual inspections

and diagnostic testing. The HERS provider and rater shall be independent entities from the builder or subcontractor installer of the energy efficiency improvements being tested and verified, and shall have no financial interest in the installation of the improvements.

7.2 HERS Required Verification and Diagnostic Testing

HERS diagnostic testing and field verification is required for ~~compliance credit for~~:

- duct air sealing,
- ACCA Manual D design and installation,
- and building envelope sealing beyond improvements covered by default assumptions,

HERS field verification is required for ~~compliance credit for~~:

- thermostatic expansion valves,
- duct surface area reductions, and
- duct location improvements beyond those covered by default assumptions.

~~For compliance credit to be claimed for t~~These features~~, they~~ shall be listed as *HERS Verification Required* features on the *Certificate of Compliance* (CF-1R) and the *Computer Method Summary* (C-2R). Such verification constitutes "eligibility and installation criteria" for these features. Field verified and diagnostically tested features must be described in the *Compliance Supplement*.

7.3 Installer Certification

When compliance or compliance credit includes ~~has been claimed for~~ duct sealing, ACCA Manual D design and installation ~~and~~or envelope sealing, builder employees or subcontractors shall:

- complete diagnostic testing, and
- certify on the CF-6R the diagnostic test results and that the work meets the requirements for compliance credit.

For duct sealing completed at the rough-in stage of construction using aerosol sealant closures, builder employees or subcontractors shall:

- at rough-in, complete the fan pressurization test and certify on the CF-6R the diagnostic results,
- after installation of the interior finishing wall, verify sealing of the ducts using either the house pressure test or the pressure pan test or by visual inspection of all duct connections (including duct to air handler connections), and
- certify on the CF-6R the diagnostic results and that the work meets the requirements for compliance credit.

When compliance or compliance credit includeshas been claimed for a thermostatic expansion valve, duct surface area reductions and duct location improvements beyond those covered by default assumptions, builder employees or subcontractors shall:

- record the feature on the CF-6R,
- record on the CF-6R the duct surface area in each duct location, and
- certify on the CF-6R that the duct surface area and locations match those on the plans, and that the work meets the requirements for compliance credit.

Installer certifications are required for each and every housedwelling unit.

7.4 HERS Verification Procedures

At the builder's option HERS field verification and diagnostic testing shall be completed –either for each housedwelling unit or for a sample of housedwelling units of the same model. To be considered the same model, housedwelling units shall be in the same subdivision or multifamily housing development and have the same energy designs and features, including the same floor area and volume, for each dwelling unit, as shown on the CF-1R. except that a house may differ in its shading. Field verification and diagnostic testing for compliance credit for duct sealing shall use the diagnostic duct leakage from fan pressurization of ducts in Section 4.3.8.2.1 of Appendix F.

The builder shall provide the HERS provider a copy of the CF-6R containing the installer certifications required in Section 7.3. Prior to completing field verification and diagnostic testing, the HERS rater shall first verify that the installer certifications have been completed.

If the builder chooses the sampling option–, the procedures described in this section shall be followed. Sampling procedures described in this section shall be included in the *Compliance Supplement*.

7.4.1 Initial Field Verification and Testing

The HERS rater shall diagnostically test and field verify the first housedwelling unit of each model as specified in Section 7.2. This initial testing allows the builder to identify and correct any potential construction flaws or practices in the build out of each model. If field verification and diagnostic testing determines that the requirements for compliance are met, the HERS rater shall provide a signed and dated *Certificate of Field Verification and Diagnostic Testing* to the builder and the HERS provider

7.4.2 Sample Field Verification and Testing

After the initial testing is completed, the builder shall identify a group of housedwelling units of the same model from which a sample will be selected for testing, and notify the HERS provider. The group shall include those

housedwelling units expected to be ready for diagnostic testing within a 180 day period.

The builder shall identify these housedwelling units by location of County, City and either the street address or the subdivision and lot number, or the multifamily housing project name and shall identify the names and license numbers of subcontractors responsible for the duct installation, duct sealing or envelope sealing that requires diagnostic testing or field verification. The builder may add additional housedwelling units during the 180 day period by notifying the HERS provider.

The HERS rater provider shall select a minimum of one out of every seven sequentially completed housedwelling units in the group, rounded up to the next whole number, for diagnostic testing and field verification as described in Section 7.2.. When several housedwelling units are ready for testing at the same time, the HERS providerrater shall randomly select the housedwelling units to be tested. The HERS rater shall diagnostically test and field verify the housedwelling units selected by the HERS providerrater.

If field verification and diagnostic testing determines that the requirements for compliance are met, the HERS rater shall provide a signed and dated *Certificate of Field Verification and Diagnostic Testing* to the builder and the HERS provider. The *Certificate of Field Verification and Diagnostic Testing* shall report the successful diagnostic testing results and conclusions regarding compliance for the tested housedwelling unit.

The HERS rater shall provide a signed and dated *Certificate of Field Verification and Diagnostic Testing* to the builder and the HERS provider for up to six additional housedwelling units from the group. The *Certificate* shall not be provided for housedwelling units in which the feature requiring field verification and diagnostic testing has not been installed, sealed or completed.

The 180 day period shall begin on the date of the first *Certificate of Field Verification and Diagnostic Testing* for the group. The HERS provider shall determine the date the 180 day period ends, and shall notify the builder and rater. HouseDwelling units within the group for which a *Certificate of Field Verification and Diagnostic Testing* has not been completed within 180 days from the date of the first *Certificate of Field Verification and Diagnostic Testing* for the group, as determined by the HERS provider, shall either be individually tested or be included in a group of housedwelling units in a subsequent sample period.

Whenever the builder changes subcontractors who are responsible for the feature that is being diagnostically field verified and tested, the builder shall notify the HERS rater of any subcontractors who have changed, and terminate sampling for the identified group. The HERS rater shall cease certification. Whenever the builder changes HERS providers, the builder shall terminate sampling.

All ~~house~~dwelling units using *HERS Required Verification* features for compliance that were installed by previous subcontractors or were subject to verification and testing under the supervision of a previous HERS provider, for which the builder does not have a completed *Certificate of Field Verification and Diagnostic Testing*, shall either be individually tested or included in a separate group for sampling. ~~House~~Dwelling units with installations completed by new subcontractors shall either be individually tested or shall be included in a new sampling group following a new *Initial Field Verification and Testing*.

The HERS ~~provider~~ rater shall not notify the builder when sample testing will occur prior to the completion of the work that is to be tested. After the HERS ~~provider~~ rater notifies the builder when testing will occur, the builder shall not do additional work on the features being tested.

7.4.3 Re-sampling, Full Testing and Corrective Action

When a failure is encountered during sample testing, the HERS rater shall conduct re-sampling to assess whether that failure is unique or the rest of the ~~house~~dwelling units are likely to have similar failings. The HERS provider shall select for re-sampling one out of every seven of all of the untested ~~house~~dwelling units in the group that have been constructed since the beginning of the 180 day time period, rounded up to the next whole number.

If testing in all ~~house~~dwelling units in the re-sample confirms that the requirements for compliance credit are met, then the ~~house~~dwelling unit with the failure shall not be considered an indication of failure in the other ~~house~~dwelling units in the group. The builder shall take corrective action for the ~~house~~dwelling unit with the failure, and then the HERS rater shall retest to verify compliance and issue a signed and dated *Certificate of Field Verification and Diagnostic Testing* to the builder. Sampling shall then resume for the remainder of the group.

If field verification and testing in any of the ~~house~~dwelling units in the re-sample results in a second failure, the builder shall take corrective action in all unoccupied ~~house~~dwelling units in the group that have not been tested but for which a *Certificate of Field Verification and Diagnostic Testing* has been completed. The HERS rater shall conduct field verification and diagnostic testing in each of these ~~house~~dwelling units to verify that problems have been corrected and that the requirements for compliance have been met, and shall report to the HERS provider.

Builders shall offer at no charge to ~~homeowner~~building owners in occupied ~~house~~dwelling units in the group to complete field verification and testing and corrective action if necessary. ~~Homeowner~~Building owners may decline this offer. Builders shall report the identifying location of any ~~house~~dwelling unit in which the ~~homeowner~~building owner declines field verification and testing and corrective action to the HERS provider. The HERS provider shall verify that the

builder has made this offer. If a ~~homeowner~~building owner in an occupied ~~house~~dwelling unit declines this offer, field verification, testing and corrective action will not be required for that ~~house~~dwelling unit and the ~~house~~dwelling unit will no longer be considered a part of the group. If a ~~homeowner~~building owner accepts this offer, the builder shall take corrective action. The HERS rater shall then conduct field verification and diagnostic testing to verify that problems have been corrected and that the requirements for compliance have been met, and shall report to the HERS provider.

The HERS provider shall file a report with the building department explaining all action taken (including field verification, testing, corrective action, offers to ~~homeowner~~building owners for testing and corrective action and ~~homeowner~~building owner declines of such offers) to bring into compliance ~~house~~dwelling units for which a signed and dated *Certificate of Field Verification and Diagnostic Testing* has been provided to the builder. If corrective action requires work not specifically exempted by Section 112 of the UMC or Section 106 of the UBC, the builder shall obtain a permit from the building department prior to commencement of any of the work.

Until corrections, field verification and testing of all ~~house~~dwelling units in the group have been completed or ~~homeowner~~building owners in occupied ~~house~~dwelling units have declined corrective action, sampling of additional ~~house~~dwelling units in the group shall cease~~.~~. If additional ~~house~~dwelling units in the group are completed during the time required to correct, field verify and test the previously completed ~~house~~dwelling units in the group, the rater shall individually field verify and diagnostically test those additional ~~house~~dwelling units to confirm that the requirements for compliance credit are met. Once corrections, field verification and testing is completed for all ~~house~~dwelling units that have a *Certificate of Field Verification and Diagnostic Testing*, excepting those where ~~homeowner~~building owners have declined corrective action, the builder shall either resume sampling for the remainder of the ~~house~~dwelling units in the group or terminate the group.

Corrections shall not be made to a sampled ~~house~~dwelling unit to avoid a failure. If corrections are made to a sampled ~~house~~dwelling unit, corrections, field verification and testing shall be performed on 100% of the ~~house~~dwelling units in the group that have been constructed since the beginning of the 180 day period.

7.5 Responsibilities and Documentation

7.5.1 Builder

Builder employees or sub contractors responsible for completing either diagnostic testing, visual inspection or verification as specified in Section 7.3 shall certify the diagnostic testing results and that the work meets the requirements for compliance credit on the CF-6R.

The builder shall provide the HERS provider with the identifying location of the group of ~~house~~dwelling units to be included in the sample for field verification and diagnostic testing and the expected date that sampling may begin. The builder shall provide the HERS provider a copy of the CF-6R signed by the builder employees or sub-contractors certifying that diagnostic testing and installation meet the requirements for compliance credit.

The builder shall provide a *Certificate of Field Verification and Diagnostic Testing* signed and dated by the HERS rater to the building official in conjunction with requests for final inspection for each ~~house~~dwelling unit.

When resampling reveals a failure, builders shall offer at no charge to ~~homeowner~~building owners in occupied ~~house~~dwelling units in the group to complete field verification, testing and corrective action if necessary. ~~Homeowner~~Building owners may decline to have field verification and testing and corrective action completed. Builders shall report the identifying location of any ~~house~~dwelling unit in which the ~~homeowner~~building owner declines field verification and testing and corrective action to the HERS provider. Builders shall take corrective action as required in all unoccupied ~~house~~dwelling units in the group and in occupied ~~house~~dwelling units in the group where ~~homeowner~~building owners have accepted field verification, testing and corrective action.

7.5.2 HERS Provider and Rater

The HERS provider shall maintain a list of the ~~house~~dwelling units in the group from which sampling is drawn, the ~~house~~dwelling units selected for sampling, the ~~house~~dwelling units sampled and the results of the sampling, the ~~house~~dwelling units selected for re-sampling, the ~~house~~dwelling units that have been tested and verified as a result of re-sampling, the corrective action taken, and copies of all *Certificates of Field Verification and Diagnostic Testing* for a period of five years.

The HERS rater providing the diagnostic testing and verification shall sign and date a *Certificate of Field Verification and Diagnostic Testing* certifying that he/she has verified that the requirements for compliance credit have been met. *Certificates of Field Verification and Diagnostic Testing* shall be provided for the tested ~~house~~dwelling unit and each of up to six other ~~house~~dwelling units from the group for which compliance is verified based on the results of the sample. The HERS rater shall provide this certificate to the builder and the HERS provider.

The HERS Rater shall provide a separate *Certificate of Field Verification and Diagnostic Testing* for each ~~house~~dwelling unit the rater determines has met the diagnostic requirements for compliance. The HERS rater shall identify on the *Certificate of Field Verification and Diagnostic Testing* if the ~~house~~dwelling unit has been tested or if it was an untested ~~house~~dwelling unit approved as part of sample testing. The HERS rater shall not sign a *Certificate of Field Verification*

and Diagnostic Testing for a ~~house~~dwelling unit that does not have a CF-6R signed by the installer as required in Sections 7.2 and 7.5.1.

If field verification and testing on a sampled ~~house~~dwelling unit identifies a failure to meet the requirements for compliance credit, the HERS rater shall report to the HERS provider and the builder that re-sampling will be required.
If re-sampling identifies another failure, the HERS rater shall report to the HERS provider and the builder that corrective action and diagnostic testing and field verification will be required for all the untested ~~house~~dwelling units in the group that have been constructed since the beginning of the 180 day period. This report shall specify the identifying location of all ~~house~~dwelling units that must be corrected and fully tested.

The HERS provider shall also report to the builder once diagnostic testing and field verification has shown that the failures have been corrected in all of the ~~house~~dwelling units except those for which the ~~homeowner~~building owner has declined field verification, testing and corrective action.

When individual ~~house~~dwelling unit testing and verification confirms that the requirements for compliance have been met, the HERS rater shall provide a *Certificate of Field Verification and Diagnostic Testing* for each previously untested/unverified ~~house~~dwelling unit in the group and for each additional ~~house~~dwelling unit of the same model completed during the time required to correct, verify and test the previously untested/unverified ~~house~~dwelling units in the group.

The HERS provider shall file a report with the building department explaining all action taken (including field verification, testing, corrective actions, offers to ~~homeowner~~building owners for testing and corrective action, and ~~homeowner~~building owner declines of such offers) to bring into compliance ~~house~~dwelling units for which a signed and dated *Certificate of Field Verification and Diagnostic Testing* has been provided to the builder.

7.5.3 Building Department

The building department at its discretion may require independent testing and field verification in conjunction with the building department's required inspections, and/or observe the diagnostic testing and field verification performed by builder employees or subcontractors and the certified HERS rater in conjunction with the building department's required inspections to corroborate the results documented in installer certifications, and in the *Certificate of Field Verification and Diagnostic Testing*.

For ~~house~~dwelling units that have used a compliance alternative that requires field verification and diagnostic testing, the building department shall not approve a ~~house~~dwelling unit for occupancy until the building department has received from the builder a *Certificate of Field Verification and Diagnostic Testing* that has been signed and dated by the HERS rater.